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(54) Title: HEAT-REMOVABLE BANDAGE AND MEDICAL TAPE

(57) Abstract

A heat-release tape for attachment to a surface, preferably human skin. The heat-release tape includes a backing material and an adhesive applied to the backing material on one or both sides, the adhesive being pressure-sensitive at skin temperature and having a melting temperature in the range between physiological skin temperature and below a temperature at which burns or pain would result. The tape is removed from the skin using a tape-removing apparatus that includes: an external surface for being placed in contact with the tape; a source of heat disposed adjacent to the external surface for heating the external surface to a temperature exceeding the melting temperature of the adhesive; and a temperature controller for regulating the temperature of the external surface. The source of heat is a resistive wire, coil, heated fluid, or other heated object. An indicator, such as a light or audible signal, provides an indication that the temperature of the external surface is in a predetermined range once the device has been turned on. A temperature sensor located adjacent to the external surface measures the temperature of the external surface and communnicates this temperature to the temperature controller.

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HEAT-REMOVABLE BANDAGE AND MEDICAL TAPE

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention is an apparatus and method for painlessly removing medical bandages and tapes from sensitive or delicate surfaces such as human skin. More particularly, the invention relates to a medical tape backed by an adhesive that is pressure sensitive and that has hot-melt properties. The tape is removed by means of a heating device that has a heated contact surface that is thermally controlled to melt the adhesive so that the tape may be removed without causing pain, discomfort or damage to the underlying surface or skin.

2. Description of the Related Art.

Adhesive tapes of many different types are well known, e.g., packaging tape, surgical tape, medical first aid (bandage) tape, masking tape, electrical tape, Scotch$_{TM}$ tape, etc. All tapes basically consist of a strip of plastic, paper, cloth, foil, or other material that has a layer of adhesive on one of its faces.

The type of adhesive used on most tapes, e.g., medical tape, is pressure sensitive adhesive. Pressure sensitive adhesives are well known and are described in, for example, Handbook of Adhesion, D.E. Packham Ed., John Wiley & Sons Inc., New York, (1992); Handbook of Adhesive Technology, A. Pizzi & K.L. Mittal Eds., Marcel Dekker, Inc. New York,

(1994); and Handbook of Adhesives, I. Skeist Ed., Van Nostrand Reinhold, New York, (1990).

The basic property of pressure sensitive adhesives is that they rapidly adhere to most surfaces under moderate pressure and remain tacky after they are removed from the surface, even a few times. There exist many well-known pressure sensitive adhesives, such as, for example, natural rubber, carboxylated styrene-butadiene rubber latices, acrylic latex, copolymers based on styrene end blocks and a rubbery midblock of isoprene, butadiene, ethylene-butylene and styrene-butadiene multiblock copolymers.

Tapes that use pressure sensitive adhesives are commonly used in the health care, first aid and other medical fields. These tapes are easy to apply to the skin surface, but removing them from the skin may be quite painful. The pain results from the tension applied to the skin by the adhesive during removal of the tape. This pain is especially severe in hairy areas since the tape pulls on the hair as it is removed. Beside the pain and discomfort associated with removal of the tape, it is common to shave the hair from the areas to be taped, which may result in embarrassment or inconvenience to the patient. For example, it is common to shave the chest hair before applying self-sticking ECG electrodes.

Pressure sensitive tapes are sometimes avoided for use over cuts, sutures, etc. because removal of the tape may break open the wound and thus interfere with the healing process. One common way to avoid this problem is to provide

an area on the bandage that has no adhesive. This area is then placed over the most sensitive area of the wound. With such bandages, the area of the wound that would most benefit from the adhesive by being kept in close contact, e.g., the opposing edges of a cut, so that it would heal faster, is not held in place by the adhesive.

Another class of adhesives used on tapes is hot-melt adhesives. Such tapes are, for example, used for packaging, and are generally not used for medical applications. Hot-melt adhesives are fluid at relatively high temperatures and set at lower temperatures. Tapes that use hot-melt adhesives are applied when hot and are left to cool, at which point the tape will set and adhere to the surface. Some examples of hot melt adhesives are polyamide, polyester, ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, amorphous polypropylene and vinyl ether resins. Other pressure-sensitive and hot-melt adhesives are described in the aforementioned books Handbook of Adhesion, Handbook of Adhesive Technology, and Handbook of Adhesives, the content of each of which is incorporated herein by reference.

Adhesives may be formulated, by the addition of resins and plasticizers, for example, that possess both pressure sensitive and hot-melt characteristics. One such formulation includes styrene butadiene multiblock copolymers. Other adhesives which are either pressure-sensitive or have hot-melt characteristics, can be modified to possess both properties by means of additives. These composite adhesives are also not used in medical applications.

It would be desirable to have an adhesive tape or bandage for use in the medical field that reduces the pain associated with removal of the tape or bandage, that obviates the need for shaving hair prior to use of the tape or bandage, that may be applied directly over wounds, and that may be used on delicate surfaces.

SUMMARY OF THE INVENTION

The present invention is a heat-release tape for attachment to a surface, preferably human skin. The heat-release tape includes a backing material and an adhesive applied to the backing material on one or both sides, the adhesive being pressure-sensitive at skin temperature and having a melting temperature in the range between physiological skin temperature and below a temperature at which burns or pain would result.

The pressure-sensitive hot-melt adhesive is preferably selected from Cumar Series Tapiocas, polyamides, ethylene-vinyl acetate copolymers, block copolymers, including copolymers of styrene and butadiene, styrene and isoprene, and styrene and ethylene-butylene, polyester polymers that comprise 1,6-Hexanediol, or any other adhesive having the desired properties.

The backing material may be crepe paper, aluminum foil, fabric, such as cotton or nylon, cellophane, Kraft paper, cellulose acetate, polyester film, polyethylene, polypropylene, polyvinyl chloride, woven glass fiber cloth or any other appropriate backing material.

The tape is preferably removed from the skin using a

tape-removing apparatus that includes:

a) an external surface for being placed in contact with the tape;

b) a source of heat disposed adjacent to the external surface for heating the external surface to a temperature exceeding the melting temperature of the adhesive; and

c) a temperature controller for regulating the temperature of the external surface.

Any appropriate source of power may be used to operate the tape remover. The source of heat is preferably a resistive wire, coil, or pumped heated fluid. An indicator, such as a light or audible signal, provides an indication that the temperature of the external surface is in a predetermined range once the device has been turned on.

If desired, a heat retaining fluid may be located between the external surface and the source of heat for retaining the heat generated by the heat source so as to keep the external surface hot. A temperature sensor located adjacent to the external surface measures the temperature of the external surface and communicates this temperature to the temperature controller. In one embodiment of the invention, the external surface, the source of heat and the temperature sensor are removable as a unit and interchangeable.

In a method of taping a surface according to the invention, the tape is applied to and adheres to the skin. To remove the tape, the tape is heated until the pressure-sensitive hot-melt adhesive melts; and then the tape is

removed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-section view of tape of the present invention applied to the skin surface.

FIG. 2 is a cross-section view of a tape remover in accordance with the present invention with an interchangeable heat exchanger.

FIG. 3 is a cross-section view of a tape remover according to the present invention with a heat exchanger activated by an internal heating element.

FIG. 4 is a cross-section view of a tape remover according to the present invention with a heat exchanger activated by an external heating system.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is a medical or other tape 2, that consists of a backing material 3 having a pressure-sensitive hot-melt adhesive 4 affixed to the backing material on at least one of its surfaces. The tape is removed by means of a tape removal heating device 6 (Figs. 2-4).

Backing material 2 may be constructed of any conventional material suitable for taping, depending upon the primary use of the tape. For example, backing material 2 may be crepe paper, aluminum foil, fabric, such as nylon or cotton, cellophane, Kraft paper, cellulose acetate, polyester film, polyethylene, polypropylene, polyvinyl chloride, woven glass fiber cloth, or any other appropriate flexible material.

The essential property of pressure-sensitive hot-

melt adhesive 4 is that it have a melting or softening temperature that is higher than the normal physiological range of human skin surface temperature, generally 30-37° C (86-98.6° F), and that is lower than the temperature that causes pain or damage to the skin, generally 45-50° C (113-122° F). Preferably, the melting point of the adhesive is in the range of 40-44° C (104-111.2° F). The heat-sensitivity of the adhesive preferably has a steep slope, similar to a phase transition, so that the adhesive will have strong adhesion up to the melting temperature of the adhesive.

Examples of pressure-sensitive hot-melt adhesives that soften or liquefy in the preferred temperature range and that are tacky, i.e., pressure sensitive, include thermoplastic rubbers such as the Cumar Series Tapiocas, which can be made to have softening temperatures over the range of 10-130°C (See the aforementioned Handbook of Adhesives, p. 248; and Handbook of Adhesive Technology, p. 451), polyamides which may have softening temperatures in the range of 43-53°C (Handbook of Adhesives, p. 481), ethylene - vinyl acetate copolymers, block copolymers, including copolymers of styrene and butadiene, isoprene or ethylene-butylene (Handbook of Adhesives, p. 409), and polyester polymers that incorporate the monomer - 1,6-Hexanediol, which has a melt point of 42°C (Handbook of Adhesives, p. 490).

It is foreseen that there exist other adhesives that have pressure-sensitive and hot-melt characteristics. References to other such adhesives can be found in the aforementioned Handbook of Adhesion, Handbook of Adhesive

Technology, and Handbook of Adhesives.

Moreover, techniques for causing hot melt adhesives that are not tacky to become tacky are well known in the art. One such technique involves the addition of resins or plasticizers to the adhesive. Examples of commonly used tackifying resins and plasticizers include: rosin, dimerized rosin, rosin esters, ketone resins, maleic resins, paratoluene sulfonamide, N-Ethyl paratoluene sulfonamide, N-Cyclohexyl paratoluene sulfonamide, triphenyl phosphate, tributyl phosphate, phthalate esters, and castor oil (See, Handbook of Adhesives, p. 482).

It is foreseen that many of the aforementioned pressure-sensitive hot-melt adhesives that melt at between at above the normal range of body temperatures can be used as the adhesive on the tape of the present invention. When the tape is applied to the human skin, or other delicate surface, at temperatures below the melting point of the adhesive, e.g., room temperature, the tape will adhere to the skin like a normal bandage. By heating the tape to a temperature above the melting temperature of the adhesive, a temperature which is still below a temperatures that will cause pain or burns, the pressure-sensitive hot-melt adhesive will melt or soften. Once this occurs, the tape can be easily peeled off or removed from the skin without causing pain or damage to the wound covered by the tape.

As shown in Figs. 2-4, the removal of the tape is preferably accomplished by means of a heated tape remover 6. Tape remover 6 includes a heat exchanger 8, a heating element

10, a temperature measuring probe 12, a temperature controller 14 and a power supply 16.

As shown in Fig. 3, heat exchanger 8 is preferably constructed of a flexible material 18 that forms a closed bag around the source of heat. One face or surface 40 of the flexible material 18 makes contact with the tape 2 positioned on the user's skin. Flexible material 18 is preferably a plastic or fabric that is sufficiently flexible to conform to the contours of the skin surface at the point of attachment 9 of the bandage.

In an alternative embodiment of the heat exchanger, as shown in Fig. 2, heat exchanger 8 is preferably constructed of a flexible material 18 that forms a closed bag having enclosed therein a fluid 20 having a high heat capacity. In this embodiment, flexible material 18 may be any fluid-proof thin flexible material, and heat-retaining fluid 20 may be any fluid known in the art that has heat-retention capabilities.

The contact surface 40 of the heat exchanger is preferably flexible so as to make close contact with the tape and so as to attain the shape of the specific skin surface to which the tape is adhered. If desired, the contact surface of the heat exchanger may be covered by a material with a high heat conductivity, such as a metal, and more preferably a metal foil.

Temperature measuring probe 12 is embedded within the exchanger 8 near the flexible contact surface 40 so that it measures the temperature near the skin. Temperature measuring probe 12 may be of any type known in the art, e.g.,

a thermocouple, thermistor, digital temperature sensor, etc. Electrical connections between the temperature measuring probe 12 and a temperature controller 14 are preferably made with conventional electrical wires and connectors.

Heat exchanger 8 is heated by heating element 10 to a preset, or user-selectable, temperature that is regulated by temperature controller 14. Heating element 10 is preferably a resistive wire, coil or other conventional heating element, as shown in Figs. 2 and 3. In order to heat the device, temperature controller 14 regulates an electric current supplied by power supply 16 through heating element 10. In an alternative embodiment, as shown in Fig. 4, heat for the heat exchanger may be provided by means of a circulating fluid 42 that is heated by a remote heating source. This fluid may be heated in a heating unit (not shown) outside of the heat exchanger, either in the tape remover 6 or external thereto, and pumped through tubing 28 by means of a pump (not shown). In this embodiment, flow of the fluid 42 through tubes 28 is regulated by controller 14 to regulate the temperature of the heat exchanger 8. Regardless of the heat source, the heat is dissipated through the flexible surface 40 to tape 2.

Temperature controller 14 is preferably any type of controller known in the art, e.g., a microprocessor, on-off controller, proportional controller, fuzzy logic controller, etc. The controller 14 preferably includes an indicator 30, such as an LED or an audio sound generator, that indicates when the heat-exchanger temperature is within an acceptable range, i.e., higher than the melting or softening temperature

of the adhesive and lower than a temperature that may cause burns or significant discomfort.

Power source 16 may be any appropriate power source, such as batteries or an AC or DC power supply. Power source 16 may be an external source of power, and tape remover 6 may include a transformer if necessary. Tape remover 6 is preferably heated to a preselected value as determined by temperature controller 14 once the device is turned on. Alternatively, a user-selectable switch (not shown) such as a dial, may enable the user to select the temperature of the device within a safe range. Preselected temperature settings may be provided as well which might be used on different skin areas since skin heat sensitivity varies from location to location. Once the heat exchanger has been turned on by means of a conventional switch (not shown), it preferably maintains the desired temperature until it is turned off so that it will always be available to remove tapes and bandages using the pressure-sensitive hot-melt adhesive.

The shape of the heat exchanger that makes contact with the skin may vary, but is preferably similar in size and shape to the adhesive tape or bandage incorporating the pressure-sensitive hot-melt adhesive so that it may efficiently heat the tape or bandage without heating too much of the surrounding area. As shown in Fig. 2, in order to enable the tape remover 6 to be used with bandages of different sizes, heat exchanger 8 may be removable and interchangeable with heat exchangers having different sizes and shapes so as to fit the tape or bandage in use. In this

embodiment, the heat exchanger 8 has two or more extensions 32 that engage with corresponding recesses 34 on tape remover 6. Electrical connectors 36 are provided to electrically connect temperature probe 12 and heating element 10 to the tape remover when the removable heat exchanger is attached thereto. Any appropriate latching mechanism may be used to enable the heat exchanger 8 to attach to and separate from the main unit. In an alternative embodiment, heating element 10 and/or probe 12 may be contained in the tape remover itself, and the flexible surface 40 only may then be removable.

In use, an adhesive bandage according to the invention is applied to the skin surface at the desired location in the normal way, i.e, a protective layer, preferably a plastic strip that covers the adhesive is removed, and the bandage is pressed onto the skin at the desired location. The pressure-sensitive non-melt adhesive keeps the bandage secure until the user desires to remove it. Tape remover 6 is then turned on and the user waits for the indicator signal, which indicates that the heat exchanger temperature is in the correct range. The user then applies the heat exchanging surface of the tape remover to the skin area in question. The heat from the heat exchanger brings the adhesive to its melting or softening point at which time the user can remove the tape remover from the body surface and immediately remove the tape by peeling or pulling on it. The removal of the tape in this manner does not cause pain, even when the bandage is applied in hairy areas.

It is foreseen that the tape of the present

invention may be removed without the use of the aforementioned tape remover. For example, the tape may be removed by immersion in water at a temperature sufficient to melt the adhesive but not hot enough to cause a burn or severe discomfort. Alternatively, a vessel made of metal, glass or a heat-conducting material may be filled with a hot liquid. The vessel may then be applied to the tape. If desired, a temperature range indicator, such as those that change color at predetermined temperatures, may be used as an indicator on the heated vessel. With such an indicator, any heatable object may be used to remove the tape.

Although the present invention has been described in detail with respect to certain embodiments and examples, variations and modifications exist which are within the scope of the invention as defined in the following claims.

CLAIMS

1. A heat-release tape for attachment to a surface, the heat-release tape comprising:

a) a backing material; and

b) an adhesive applied to at least one side of the backing material, the adhesive being pressure-sensitive at physiological skin temperature and having a melting temperature in the range of between physiological skin temperature and 50°C.

2. The heat-release tape according to claim 1 wherein the pressure-sensitive hot-melt adhesive has a melting point in the range of 40-44° C.

3. The heat-release tape according to claim 1 wherein the pressure-sensitive hot-melt adhesive is selected from the group consisting of Cumar Series Tapiocas, polyamides, ethylene - vinyl acetate copolymers, block copolymers, copolymers of styrene and butadiene, isoprene or ethylene-butylene, and polyester polymers that comprise 1,6-Hexanediol.

4. The heat-release tape according to claim 1 wherein the backing material is selected from the group consisting of crepe paper, aluminum foil, fabric, cellophane, Kraft paper, cellulose acetate, polyester film, polyethylene, polypropylene, polyvinyl chloride, and woven glass fiber cloth.

5. The heat-release tape according to claim 1 wherein the pressure-sensitive hot-melt adhesive comprises a tackifying resin or plasticizer selected from the group

consisting of rosin, dimerized rosin, rosin esters, ketone resins, maleic resins, paratoluene sulfonamide, N-ethyl paratoluene sulfonamide, N-cyclohexyl paratoluene sulfonamide, triphenyl phosphate, tributyl phosphate, phthalate esters, and castor oil.

6. An apparatus for removing tape, the tape comprising an adhesive having a melting temperature, the apparatus comprising:

a) an external surface for being placed in contact with the tape;

b) a source of heat disposed adjacent to the external surface for heating the external surface to a temperature exceeding the melting temperature of the adhesive; and

c) means for regulating the temperature of the external surface.

7. The apparatus according to claim 6 wherein the means for regulating the temperature is a temperature controller, and further comprising a source of power for the temperature controller and the source of heat.

8. The apparatus according to claim 6 wherein the source of heat is a resistive wire, coil, hot water, heat retaining fluid, or pumped heated fluid.

9. The apparatus according to claim 6 further comprising an indicator for providing an indication that the temperature of the external surface is in a predetermined range. a. The apparatus according to claim 6 further comprising a heat retaining fluid located between the external

surface and the source of heat.

10. The apparatus according to claim 6 further comprising a temperature sensor located adjacent to the external surface for measuring the temperature of the external surface and for communicating the temperature of the external surface to the controller.

11. The apparatus according to claim 6 wherein the external surface is interchangeable.

12. The apparatus according to claim 11 wherein the external surface, the source of heat and the temperature sensor are removable as a unit and interchangeable.

13. A method of applying and removing tape from a surface, the method comprising:

a) applying a tape to the surface, the tape comprising a backing material and an adhesive applied to the backing material, the adhesive being pressure-sensitive at skin temperature and having a melting temperature in the range of between physiological skin temperature and 50°C;

b) heating the tape until the pressure-sensitive hot-melt adhesive melts; and

c) removing the tape.

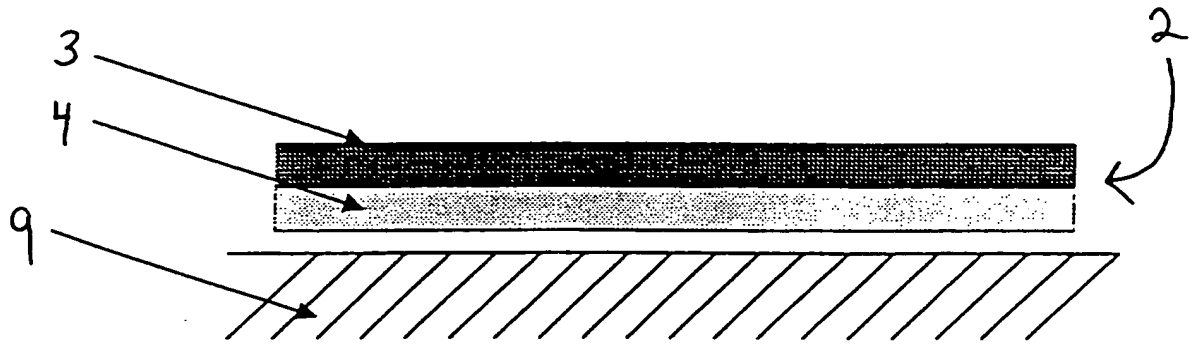

FIGURE 1

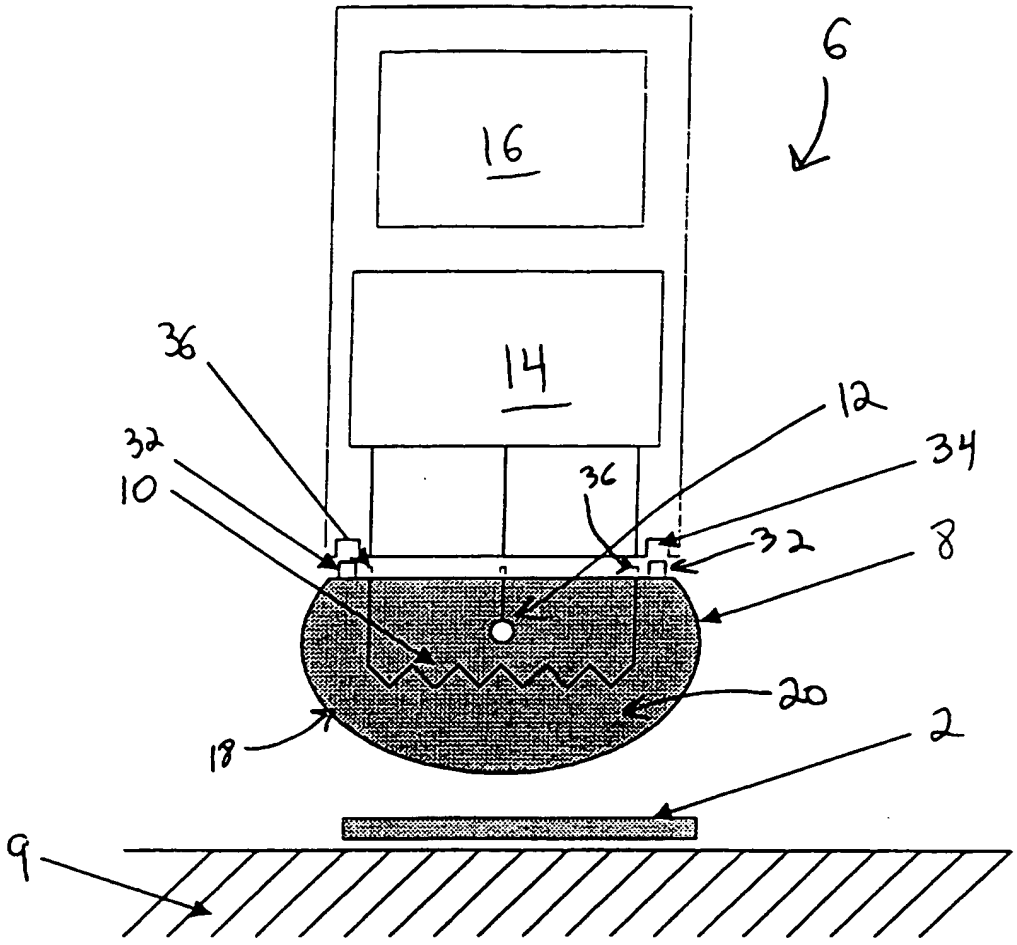

FIGURE 2

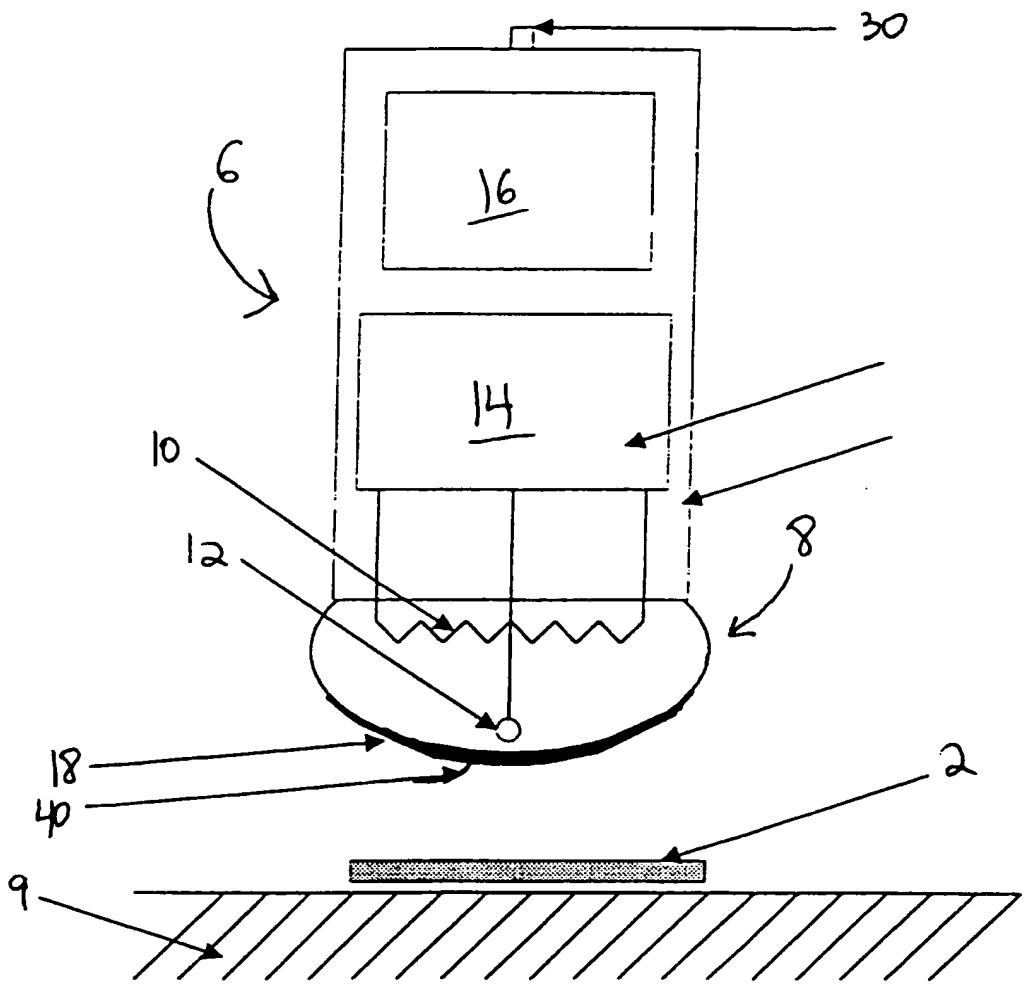

FIGURE 3

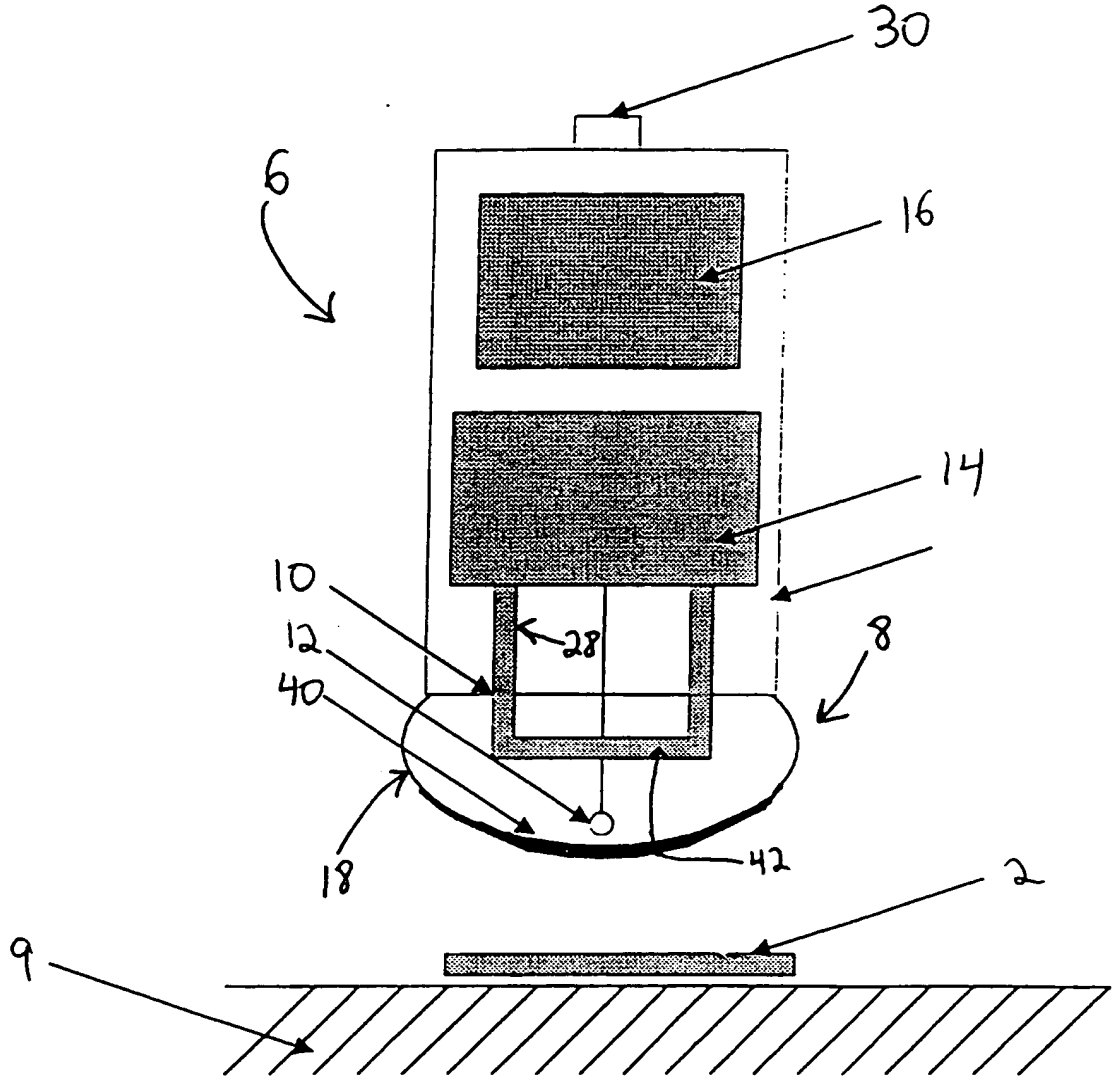

Figure 4